A SUMMARY OF THE RELATIONSHIP BETWEEN BLOOD LEAD AND DETERIORATED PAINT, AS REPORTED IN SCIENTIFIC LITERATURE

Over 83 percent of the private homes built before 1980 in the United States are estimated to contain some components covered with lead-based paint [7]. Over time, as painted surfaces weather, are disturbed, and age, lead-based paint is more prone to deterioration (e.g., peeling, chipping, or cracking). The purpose of this paper is to identify and summarize published information on the relationship between children's blood-lead levels and some measure of deteriorated paint, such as the presence of deteriorated paint or the square footage of deteriorated paint. The information on the subject in the published literature is limited. Based on three studies located in this literature search, there is evidence that the presence of deteriorated lead-based paint is related to the frequency of elevated blood-lead levels. A fourth study showed no significant association between paint quality and blood-lead levels. No information quantifying the relationship between deteriorated paint and blood-lead levels, such as a slope factor relating square feet of deteriorated paint to blood-lead levels, was uncovered. Discussion of the studies addressing the association between deteriorated lead-based paint and elevated blood-lead levels follows.

Clark et al. [2] suggests that infant blood-lead levels are a function of paint deterioration and lack of maintenance of the residence. Private, pre-World War II, non-rehabilitated housing was classified as "in a deteriorated state" if its exterior was either not well-maintained or had peeling paint, as observed from the street. If neither condition held, housing was considered in a satisfactory state. In this study, blood-lead levels for 21 infants in Cincinnati in private, pre-World War II non-rehabilitated housing were monitored over the infants' first 18 months. These infants were selected from those already participating in a prospective study [1]. For infants at 12 to 18 months old, geometric mean blood-lead levels were twice as high in deteriorated housing (geometric mean paint lead level of 11.7 mg/cm^2) than in housing graded as satisfactory (geometric mean paint lead level of 10 mg/cm^2). In deteriorated housing, geometric mean blood-lead

levels increased to approximately 33 µg/dL by the time the infants reached 18 months, while a peak of only 15 µg/dL was observed among infants in satisfactory housing.

Gilbert et al. [3] documents results of a limited case-control study which investigated the odds ratio for risk of lead toxicity in certain situations (i.e., the odds of being lead poisoned for children in a given situation versus children not in that situation). Odds ratios were greater than 10 for children exposed to deteriorated lead-based paint, indicating that these children were more than ten times more likely to be lead poisoned when exposed to deteriorated lead-based paint compared to children who were not exposed. However, the cases considered in this study were all observed to have blood-lead levels exceeding 50 µg/dL. It is unclear whether similar odds would hold for children with lower blood-lead levels. Information from this study was relayed through Schwartz and Levin [6].

Greene et al. [4] investigated the relationship between blood-lead level and a number of risk factors, including the presence of peeling paint, although no indication of lead levels in the paint was provided. Blood-lead levels were measured for 270 children in Cleveland, where each child was measured at one or more of the following ages: 2 years, 3 years, and 4 years 10 months. Mothers of these children delivered at a single hospital (which served primarily inner-city, disadvantaged families) and were selected from a larger sample of women participating in a study of the effects of fetal alcohol exposure. Dates of the study were not provided. The geometric mean blood-lead levels of the children were 15.6 (at age 2 years), 15.7 (at age 3 years), and 14.2 (at age 4 years 10 months) µg/dL. Table 1 presents a number of correlation coefficients between the presence of peeling paint and children's blood-lead levels. Unadjusted correlations between presence of peeling exterior paint and blood-lead levels in two-year-olds and between presence of peeling interior paint and blood-lead levels in three-year-olds were statistically significant at the 0.05 level. Partial correlations (i.e., correlations adjusting for effects of other predictor variables) for these same pairs were still statistically significant at the 0.05 level when other predictor variables such as pica tendencies, home cleanliness, and quality of home environment were considered. Presence of peeling exterior paint was chosen among

the most influential covariates in a stepwise regression analysis for blood-lead levels of two-year-olds. This regression analysis concluded that the presence of peeling exterior paint led to an estimated 17.5% increase in blood-lead level for two-year-olds (R^2=0.46). However, the lead levels in paint were not reported in the paper. Therefore, it is not certain that the results of this study actually represent deteriorated paint that contains lead.

Table 1. Correlation Coefficients Presented in Greene et al. (1992)

Variable	Blood-Lead		
	Aged 2 years	**Aged 3 years**	**Aged 4 years, 10 months**
Unadjusted Pearson correlation coefficients			
Presence of Peeling Paint (interior)	0.07	0.23*	0.04
Presence of Peeling Paint (exterior)	0.16*	0.03	-0.02
Partial correlation coefficients[1]			
Presence of Peeling Paint (interior)	0.02	0.16*	0.06
Presence of Peeling Paint (exterior)	0.17*	0.03	0.05

* Significant at the 0.05 level

[1] Other predictor variables include pica tendencies, home cleanliness, and scores that represent socio-demographic variables and substance use.

In contrast to the three previously discussed studies, the Rochester Lead-in-Dust Study [5] found no statistically significant relationship between interior paint quality, as determined from a visual inspection of the residence, and children's blood-lead levels. Interior paint quality was included as a variable in a multiple regression analysis to predict log-transformed children's blood-lead levels as a function of a number of environmental, behavioral, and socio-economic variables. The geometric mean blood-lead level for the 205 children in the study was 7.7 µg/dL. The median paint-lead level reported was 1.0 mg/cm^2 for interior and 7.0 mg/cm^2 for exterior surfaces. The slope coefficient for the interior paint quality variable was not found to be significantly different from zero at the 0.05 level and was not among those variables selected in a stepwise regression model.

It should be noted that in most studies which estimate slope coefficients in predicting blood-lead levels from environmental lead-levels (including studies cited in this technical paper), no adjustments are made for the effect of measurement error in the environmental lead levels. If measurement error in the environmental lead levels is not small relative to measurement error in the blood-lead levels, then the slope coefficient may be underestimated, thereby diminishing any inference made on the actual relationship to blood-lead levels.

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